WHAT IS CLAIMED IS:

1   1.   An apparatus for plurality signal generation, comprising:

2   a digital baseband generator that generates a digital baseband input signal,

3   a controller that receives and processes the digital baseband signal to generate

4   at least one time delayed, gain adjusted driving signal;

5   a reference RF up-converter that converts a first one of the driving signals to a

6   desired RF reference signal;

7   a predistortion RF up-converter that combines a second one of the driving

8   signals with a predistortion signal and converts the combined pre-distorted signal to a

9   RF predistortion signal;

10   an amplifier that amplifies the RF predistortion signal;

11   a comparator that compares a sample of the RF predistortion signal with the RF

12   reference signal and outputs an error signal corresponding to the comparison;

13   a wide-band feed forward loop that amplifies the error signal and combines, in

14   anti-phase, the amplified error signal with the amplified RF predistortion signal to

15   produce an output signal;

16   a measurement RF down-converter that samples and measures the error signal

17   to provide a corresponding digital sampled error signal to the controller; and

18   an adaptive estimator processor operatively coupled to the controller to estimate

19   the performance of the apparatus by comparing the measured error signal with a

20   delayed copy of the input signal and provide estimate information to the controller to

21   support adaptive updating of the controller.

1   2.   The apparatus of claim 1, further comprising an output sampler that

2   samples the output signal, an error sampler that samples the error signal and a RF-

3   switch that selectively provides each of the sampled output and error signals to the

4   measurement RF converter.

1   3.   The apparatus of claim 1, wherein the predistortion RF up-converter

2   comprises correction circuitry, the correction circuitry including:

3   respective I and Q digital multipliers that multiply digital I and Q signals

4   representing the second one of the driving signals by respective gain correction factors;

5   a phase rotator that multiplies the digital I and Q signals by a phase rotation

6   correction vector;

7   respective I and Q FIR filters that correct frequency response errors in the digital

8   I and Q signals;

9   respective I and Q summers that adjust a DC offset of the digital I and Q signals;

10   respective I and Q DACs that convert the digital I and Q signals to respective

11   first and second analog signals;

12   respective LPFs that filter the first and second orthogonal analog signals; and

13   an analog modulator that combines and modulates the first and second signals

14   to provide an analog predistortion signal.

1   4.   The apparatus of claim 1, wherein the measurement RF down-converter

2   comprises correction circuitry, the correction circuitry including:

3   an analog demodulator that demodulates the sampled output signal and

4   provides first and second orthogonal analog signals;

5   respective LPFs that filter the first and second analog signals;

6   respective I and Q ADCs that convert the first and second analog signals to

7   respective digital I and Q signals;

8   respective I and Q digital multipliers that multiply digital I and Q signals by

9   respective gain correction factors;

10   a phase rotator that multiplies the digital I and Q signals by a phase rotation

11   correction vector;

12   respective I and Q FIR filters that correct frequency response errors in the digital

13   I and Q signals; and

14   respective I and Q summers that adjust a DC offset of the digital I and Q signals.

1   5.   The apparatus of claim 1, wherein the predistortion RF up-converter

2   includes active IF LO-cancellation circuitry.

1   6.   The apparatus of claim 3, wherein the RF-switch includes an external

2   calibration port .

1   7.   The apparatus of claim 1, wherein a pilot tone signal is added to the

2   second driving signal at the controller, the pilot tone signal also being sampled and sent

3   to the adaptive estimator processor by the controller, the adaptive estimator processor

4   receives a sample of the output signal, performs a synchronized detection of the pilot

5   signal, and uses the detected information to adjust the wide-band feed forward loop.

1   8.   The apparatus of claim 5, wherein the predistortion RF up-converter

2   and the measurement RF down-converter include active RF LO-cancellation circuitry.

1   9.   The apparatus of claim 1, wherein the predistortion RF up-converter

2   and the measurement RF down-converter include adjustable attenuators.

1   10.   The apparatus of claim 1, wherein the predistortion RF up-converter

2   and the measurement RF down-converter operate at different RF-frequencies.

1   11.   An apparatus for plurality signal generation, comprising:

2   a digital baseband generator that generates a digital baseband input signal,

3   a controller that receives and processes the digital baseband signal to generate

4   at least one time delayed, gain adjusted driving signal, said controller including at least

5   one serial programmable interface port that controls frequency settings of PLL

6   synthesizer circuits, DAC and ADC clock's, gain setting blocks and digitally controlled

7   gain/phase adjuster to apply optimum adjustment of analog error canceling in the

8   apparatus;

9   a reference RF up-converter that converts a first one of the driving signals to a

10   desired RF reference signal;

11   a predistortion RF up-converter that combines a second one of the driving

12   signals with a predistortion signal and converts the combined pre-distorted signal to a

13   RF predistortion signal;

14   an amplifier that amplifies the RF predistortion signal;

15   a comparator that compares a sample of the RF predistortion signal with the RF

16   reference signal and outputs an error signal corresponding to the comparison;

17   a wide-band feed forward loop that amplifies the error signal and combines, in

18   anti-phase, the amplified error signal with the amplified RF predistortion signal to

19   produce an output signal;

20   a measurement RF down-converter that samples and measures the error signal

21   to provide a corresponding digital sampled error signal to the controller; and

22   an adaptive estimator processor operatively coupled to the controller to estimate

23   the performance of the apparatus by comparing the measured error signal with a

24   delayed copy of the input signal and provide estimate information to the controller to

25   support adaptive updating of the controller.

1   12.   The apparatus of claim 11, wherein the controller includes a

2   compensation FIR filter that compensates for linear complex gain variation in the

3   reference up-converter, the compensation FIR filter reading filter coefficients from a

4   look up table.

1   13.   The apparatus of claim 11, wherein the controller includes a

2   compensation FIR filter that compensates for flat frequency response in the

3   measurement down-converter, the compensation FIR filter reading filter coefficients

4   from a look up table.

1   14.   The apparatus of claim 12, wherein, for reference up-converter

2   calibration, the reference up-converter is tuned to the midpoint of the used RF-band by

3   adjusting an associated RF local oscillator and generating a digital frequency-stepped

4   stimuli signal through the reference up-converter, which is individually tuned by an RF-

5   local oscillator setting and stepped in equal frequency steps over an intended frequency

6   range, input signal I/Q-data and the measured I/Q- data being provided to the controller

7   where time equalization and I/Q-correction is performed, DC-offsets are estimated, and

8   signal processing is performed to provide data to the compensation FIR to correct for

9   errors introduced in the reference up-converter.

1   15.   The apparatus of claim 13, wherein, for measurement down-converter

2   calibration, the controller generates a single carrier stimuli signal at a fixed RF-

3   frequency through the reference up-converter, the single carrier stimuli signal measured

4   by the measurement down-converter, which is individually tuned by an RF-local

5   oscillator setting and stepped in equal frequency steps over an intended frequency

6   range, input signal I/Q-data and the measured I/Q- data being provided to the controller

7   where time equalization and I/Q-correction is performed, DC-offsets are estimated, and

8   signal processing is performed to provide data to the compensation FIR to correct for

9   errors introduced in the measurement down-converter.

1   16.   The apparatus of claim 11 further comprising an output sampler that

2   samples the output signal, an error sampler that samples the error signal and a RF-

3   switch that selectively provides each of the sampled output and error signals to the

4   measurement RF converter.

1   17.   The apparatus of claim 11, wherein the predistortion RF up-converter

2   comprises correction circuitry, the correction circuitry including:

3   respective I and Q digital multipliers that multiply digital I and Q signals

4   representing the second one of the driving signals by respective gain correction factors;

5   a phase rotator that multiplies the digital I and Q signals by a phase rotation

6   correction vector;

7   respective I and Q FIR filters that correct frequency response errors in the digital

8   I and Q signals;

9   respective I and Q summers that adjust a DC offset of the digital I and Q signals;

10   respective I and Q DACs that convert the digital I and Q signals to respective

11   first and second analog signals;

12   respective LPFs that filter the first and second orthogonal analog signals; and

13   an analog modulator that combines and modulates the first and second signals

14   to provide an analog predistortion signal.

1   18.   The apparatus of claim 11, wherein the measurement RF down-

2   converter comprises correction circuitry, the correction circuitry including:

3   an analog demodulator that demodulates the sampled output signal and

4   provides first and second orthogonal analog signals;

5   respective LPFs that filter the first and second analog signals;

6   respective I and Q ADCs that convert the first and second analog signals to

7   respective digital I and Q signals;

8   respective I and Q digital multipliers that multiply digital I and Q signals by

9   respective gain correction factors;

10   a phase rotator that multiplies the digital I and Q signals by a phase rotation

11   correction vector;

12   respective I and Q FIR filters that correct frequency response errors in the digital

13   I and Q signals; and

14   respective I and Q summers that adjust a DC offset of the digital I and Q signals.

1   19.   The apparatus of claim 11, wherein the predistortion RF up-converter

2   includes active IF LO-cancellation circuitry.

1   20.   The apparatus of claim 19, wherein the predistortion RF up-converter

2   and the measurement RF down-converter include active RF LO-cancellation circuitry.

1   21.   The apparatus of claim 11, wherein the predistortion RF up-converter

2   and the measurement RF down-converter include adjustable attenuators.

1   22.   The apparatus of claim 11, wherein the predistortion RF up-converter

2   and the measurement RF down-converter operate at different RF-frequencies.